THE EXPLOSIVES ENGINEER

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Forerunner of Progress in Mining, Quarrying, Construction

Geophysical prospecting in the Gulf of Mexico is being revived as a result of recent legislation designed to clear title to tideland and offshore oil leases. Numerous factors affect this renewed activity and the work is proceeding slowly. However, exploration operations have been started and crews are steadily working their way up and down the continental shelf, prospecting for likely oil-bearing formations. In the years ahead, it is expected that billions of barrels of oil will be discovered and extracted from the deep beds underlying the coastal shelf of the Gulf.

In the article beginning on page 135, Welch Richardson describes an offshore exploration expedition, using the seismographic reflection process and the shooting of submerged charges of explosives to map the subsurface land below the water. The energy impulses produced by the detonation of the explosives are recorded on a boat equipped with specialized equipment. Later, at headquarters on land, the recordings are plotted on cross sections and the resulting maps give a specific reflecting horizon.

Seismographic exploration activity, using explosives, in the Gulf is expected to continue for several years, until the entire area is mapped.

° ° °

The construction of the John H. Kerr Dam, a 2,785-ft.-long concrete structure on the Roanoke River in Mecklenburg, Virginia, required approximately 2,000,000 tons of crushed stone for use as concrete aggregate, riprap, and blanket material, and the relocation of roadways and structures.

The contractor obtained this huge tonnage of stone by drilling and blasting a granite formation in a local quarry. Excellent fragmentation resulted from firing charges of 60% and 40% ammonia gelatin dynamite in benches 20 ft. high.

For more complete information, please turn to page 149.

EDITORIAL STAFF: Joseph I. Horty, *Editor;* Gertrude A. Donnelly, *Assistant Editor;* Elizabeth M. Joyce, *Assistant Editor;* Edward L. Grant, *Art Editor;* Frank J. Canova, *Production Manager;* Charles E. Rabenold, *Advertising Manager;* Montgomery R. Budd, *Director.*

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Views and opinions expressed by the authors of articles in this publication are their own, and they do not necessarily represent those of the publisher.

° ° °

On Saturday morning, August 8, a program of interesting events, under the auspices of The Philadelphia and Reading Coal and Iron Company, was presented in Lakewood Park Pavilion near Pottsville, Pennsylvania. The occasion marked the 49th anniversary of P and R's first-aid contests and the presentation of awards to employes of various mining units for outstanding achievements in safety. One of the highlights of the program was the presentation of the Sentinels of Safety trophy and flag to the company's Hunter Tunnel mine for having been the winner in the National Safety Competition of 1952 in the anthracite group.

A summary of the proceedings is presented on page 146.

° ° °

Nova Scotia and Cape Breton Island, separated by the waters of the 3,600-ft.-wide Strait of Canso, will soon be joined by the Canso Causeway, one of the world's most unique highways. The maximum depth of the water along the center line of the project is 187 ft., with an additional 25 ft. of silt. Specifications call for the dumping of 9,000,000 tons of broken rock into the Strait as fill material. Upon completion, the causeway will measure 4,300 ft. in length, with a base 600 ft. wide and a top surface width of 80 ft.

The contractor obtained rock for the fill by blasting tunnels into the side of a hill of granite 600 ft. high. Work goes on around the clock in three 8-hour shifts. For more operating details, please turn to page 142.

"One-man gang"

lets you use low-cost air anywhere — replaces expensive specialized equipment

Le Roi TRACTAIR

Combination 35-hp tractor — 105-cfm compressor

Why rent or buy expensive specialized equipment? Save your money — because, for a fraction of the cost, you can do most of your jobs with Tractair and attachments.

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Let this "one-man gang" show you at first hand all it can do to cut your costs. Ask your nearby Le Roi distributor to take you to see Tractairs at work.

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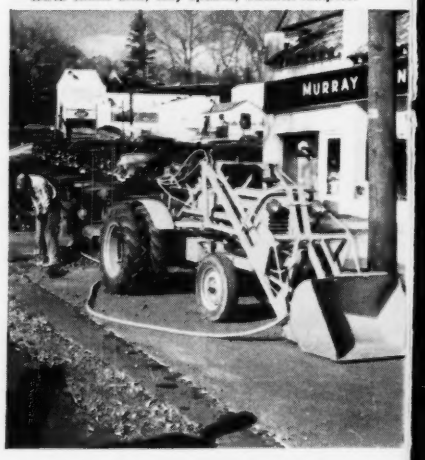
T-26

Pavement Breaking — Here, Tractair runs a Le Roi-CLEVELAND Breaker. When the job is done, Tractair mops up with its front-end loader. You also can use Tractair to run a Le Roi-CLEVELAND sinker drill, clay spades, backfill tampers.



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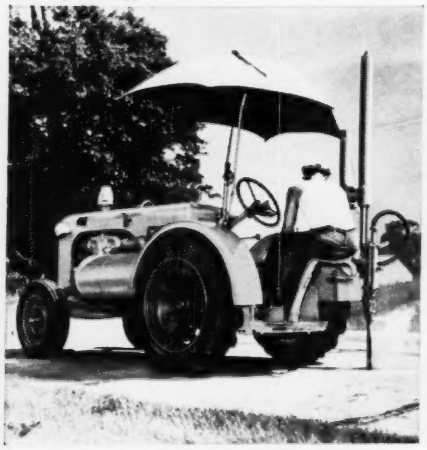
Trac-Jac — A Le Roi-CLEVELAND air-feed sinker drill mounted on Tractair. Feeding and drilling controls are within easy reach of operator. The mobility of this unit makes it ideal for mud-jacking and many other applications.



Driving Form Pins — On this highway project, Tractair puts air power to work driving form pins prior to paving. This is another example of how the usefulness of Tractair helps you to do many different jobs, reduce costs.

Earth Drilling — Tractair with utility boom operates air-motor-driven earth auger up to 16" diameter — speeds up anchor-hole digging and other earth-drilling jobs. It's another way Tractair gives you extra hours of useful service.

FRANCIS O. CASE

Francis Owen Case

PRESIDENT

GLEN ALDEN COAL COMPANY

A Biography

THE recent election of Francis Owen Case to the presidency of Glen Alden Coal Company marked the beginning of another chapter in his conspicuous record of achievement in the fields of chemistry, engineering, mining, and business administration.

Frank, as he is known to his family and friends, was born in Chattanooga, Tennessee, December 8, 1894, the son of Frank Luther and Minnie Lee (Magee) Case. His father was a professor of Greek and Latin, a lawyer, an officer in the United States Army with service in the Spanish-American War, and an excellent, self-taught linguist. He was a teacher at the Army War College in Washington, D. C., and in South American war colleges. Also, he was an observer in the Russo-Japanese War, under appointment by United States government authorities.

Frank's early education in the grade and high schools of Chattanooga was followed by matriculation at Cornell University, where he majored in chemical engineering. He worked his way through the university, where during his junior and senior years, he served as an assistant instructor in chemistry. He also played on the chemical engineering baseball team and was elected to membership in Alpha Chi Sigma fraternity. Later, he continued his engineering and business administration studies at Massachusetts Institute of Technology, University of Chicago, Northwestern University, and at Akron University.

Frank got his first job at the age of fifteen, working for a brief period as a laborer in a coal mine in Tennessee. After graduating from Cornell, he accepted a position with The New Jersey Zinc Company as a chemical engineer. In 1917, he enlisted in the United States Army Air Service and, for the next two years, was a reserve military aviator. After World War I, Frank returned to The New Jersey Zinc Company and was assigned to work in Depew, Illinois. Five years later, he resigned from Jersey Zinc to become associated with Anaconda Copper Mining Company.

He was placed in charge of that company's work on zinc oxide pigments, then lead pigments were added to his duties. His next step was to manage the company's lead refinery at East Chicago, Illinois, from which post he was elevated to midwestern manager. He continued in that capacity until 1942. With the outbreak of World War II and until its ending in 1945, Frank was general manager of Basic Magnesium at Las Vegas, Nevada, a government-owned plant, staffed and operated by Anaconda.

From 1945 to 1949, Mr. Case served as assistant to the president of Anaconda and as operating vice president of Anaconda Wire & Cable Company. In 1949, he was made a vice president of Anaconda Copper Mining Company, president of Anaconda Aluminum Company, and a director in both Anaconda Alloys Company and American Brass Company. January 28, 1953, he left Anaconda Copper Mining Company to become the president and a member of the board of directors of Glen Alden Coal Company, with headquarters in Wilkes-Barre, Pennsylvania.

Mr. Case's other business affiliations include membership on the boards of directors of Delaware, Lackawanna and Western Coal Company and of the Anthracite Institute. He is a member of the Anthracite Operators Wage Agreement Committee and of the Production Control Plan for the Anthracite Industry. He is also a member of the American Chemical Society, the American Zinc Institute, the American Institute of Mining Engineers, and the American Mining Congress. His clubs are the Cornell, the Downtown Athletic, the Midday, and the Mining in New York City, and the Westmoreland in Wilkes-Barre.

Francis Owen Case married Winifred Alice Williams in 1925, in Akron, Ohio. They have one child, Robert Owen Case, an automobile agency owner in Brigham, Utah. The family home is at 24 South River Street in Wilkes-Barre.

Frank Case finds relaxation from the demands of his business responsibilities by indulging in a variety of hobbies, including deep-sea fishing, ocean swimming, chemical laboratory and shop work, masonry work, gardening, photography, and music.

Editorial

An Appeal to Operators of Mines and Quarries

For the twenty-eighth consecutive year, we appeal to operators of mines and quarries in the United States to enroll their properties in the National Safety Competition, sponsored by the U. S. Bureau of Mines. Our appeals have been motivated by a humanitarian desire: to eliminate disabling injuries in these so-called hazardous industries by the intelligent direction and proper observance of safety methods.

The urge to produce vast quantities of coal, iron, copper, stone, lead, zinc, and the great range of metals and nonmetallics, should not swerve operators from the fundamentals of sound safety practices. In fact, with more material needed by all industry, there should be an added incentive to speed production by operating in the safest manner possible.

Year after year, the National Safety Competition has demonstrated what organized programs, bound together by a common incentive, are capable of accomplishing in the prevention of accidents. Figures on file with the Bureau of Mines in Washington emphatically prove that contests properly supervised and enthusiastically received result in infinite gain to industry.

When the first National Safety Competition was conducted in 1925, approximately 200 mines and quarries were enrolled. None of them worked through the year without a lost-time injury. The 1952 contest included 603 operations, of which 186 reported records of no lost-time injuries during a total worktime of 20,945,406 manhours of exposure.

The increase in the number of entrants in the 1952 contest is a gratifying indication that the mineral industry is alert to the increasingly important role of safety. The fact that more than 30 per cent of the enrolled mines and quarries achieved perfect safety records bears eloquent testimony to the value of the National Safety Competition as an instrument at the disposal of the mineral industry for the conservation of manpower and the achievement of maximum production.

Enrollment in the National Safety Competition offers an opportunity to mining and quarrying companies to join a crusade, a chance to demonstrate to America that men can do a job and do it safely and with greater efficiency. Write today to the Bureau of Mines, U. S. Department of the Interior, Washington 25, D. C., and enter your mine or quarry in the classification that describes your operations – anthracite, bituminous-coal, metal, nonmetallic, open-pit mines, and quarries.

A 31-Year Railroad Record

The annual report of H. A. Campbell, Chief Inspector of the Bureau of Explosives, Association of American Railroads, includes the announcement that during 1952 there were no deaths or injuries chargeable to the rail transportation of industrial explosives. This same remarkable performance record has been maintained by the railroads for 31 consecutive years.

This Bureau, organized in 1907, with the support of railroad companies and manufacturers who are associate members, has become one of the most effective safety-promotion agencies in the country. It has made, and is making, a daily contribution to safety and welfare throughout the nation.

Construction Survey Forecasts Abundant Work Ahead

Replies to a nation-wide telegraphic survey conducted by The Associated General Contractors of America reveal that the industry is expected to attain the volume of more than $34 billion in new construction in 1953, predicted early in the year. The survey also indicates that abundant work lies ahead for the industry, especially in the fields of highway and heavy-construction projects. Contractors report their ability to take on more work than formerly because of the availability of more and better equipment, well-trained and experienced supervisory personnel, and working capital.

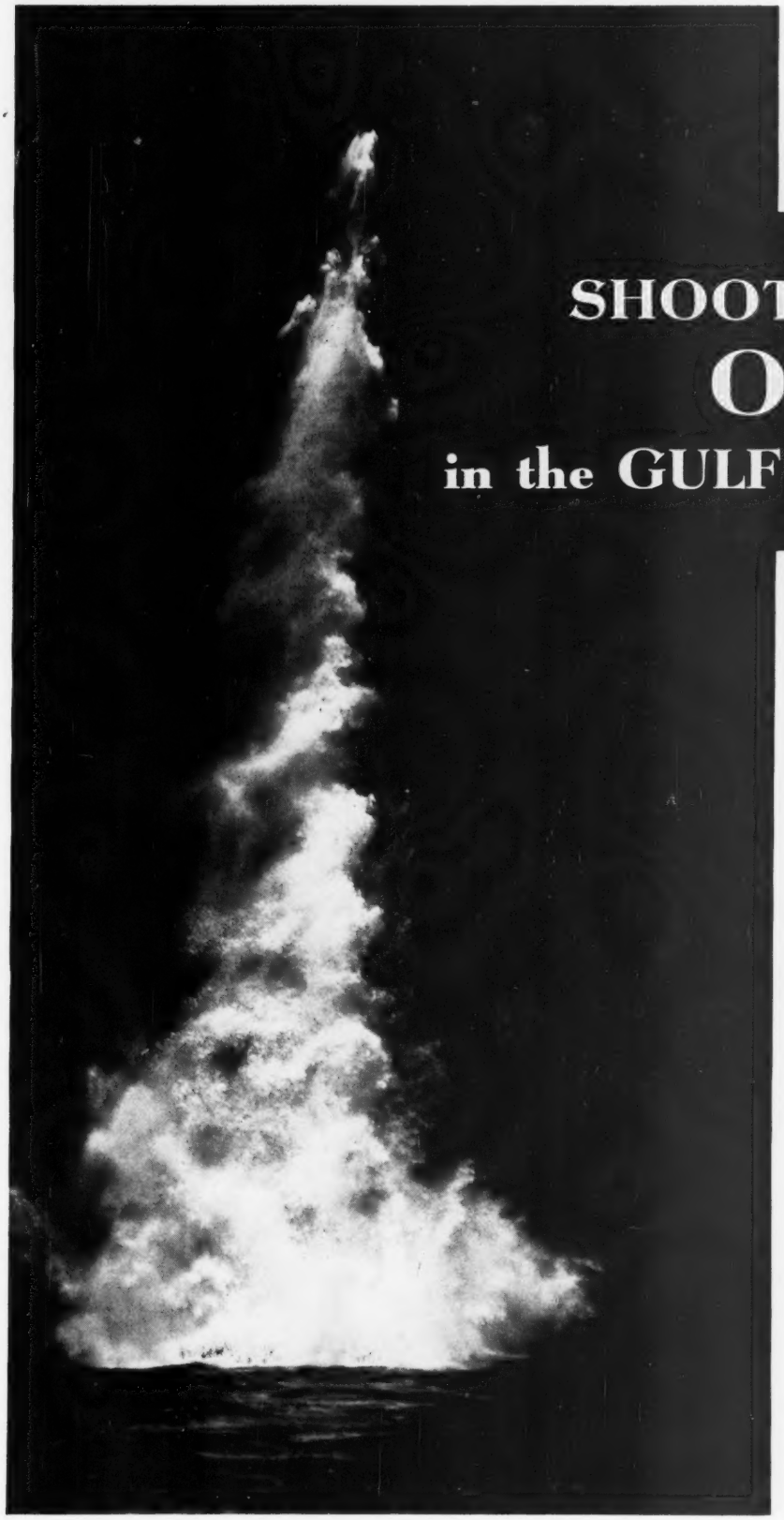
The completion of many of the projects in the overall construction program will call for a continued high level of activity for manufacturers of equipment and supplies. Much of the work will require blasting of rock formations and the production of various sizes of commercial crushed stone for road beds and surfaces. Explosives manufacturers are prepared to supply the necessary dynamite, blasting caps, and accessories for carrying on a heavy schedule of road building and heavy-construction projects throughout the nation.

Care in Storing Explosives Helps Reduce Costs

Operating costs in many mines and quarries can be reduced by better supervision in handling, storing, and using industrial explosives. Like other manufactured products, dynamite, blasting powder, and detonators deteriorate if kept too long. Rules should be established and strictly enforced requiring that new stock be piled in the rear of magazines so that the older stock will be in the front and used first.

Magazines for the storage of explosives should be dry, clean, and well ventilated – not subject to extremes of heat and cold. They should be bulletproof and fire resistant. No nails or bolts should be exposed. Fire, sparks, or matches should never be allowed near them.

The ground around magazines, for at least 25 ft. in all directions, should be kept clear of grass, leaves, brush, debris, and other flammable material.



SUBMARINE BLASTING: The firing of a 40-lb. charge of Vibronite-B shoots a column of water several hundred feet into the air. The detonation of the explosives sends energy impulses down through the water and sedimentation to the formations below.

SHOOTING for OIL in the GULF of MEXICO

Seismic crews, using explosives and seismographic reflection methods, work steadily up and down the continental shelf, prospecting for oil-bearing formations in the area

WELCH RICHARDSON*

THE continually increasing demand for petroleum, the necessity for finding new reserves, and the recent legislation designed to clear title to tideland and offshore oil leases are leading to a revival of geophysical prospecting in the Gulf of Mexico, using seismographic application of the reflection method with explosives. Numerous factors affect this renewed activity and the work is proceeding slowly. In the years ahead, it is expected that billions of barrels of oil will be discovered and extracted from the deep beds underlying the coastal shelf of the Gulf of Mexico.

There are many difficult and expensive steps to be taken by oil companies before this happens. However, exploration activities have been started and a large number of crews are steadily working their way up and down the

*750 West Levee Street
Brownsville, Texas

MOVING OUT TO SEA: Aboard the survey boat moving out into the Gulf of Mexico off the coast of Texas, geophysical surveyors lay lines for exploration shooting of explosives charges, using a land-based triangulation method.

MARKING THE SHOT LINE: Proceeding on a straight line from the flag point by compass readings, the survey ship's crew drops 20-lb. weights attached to floats and large numbered balloons at intervals, to mark the shot line.

continental shelf, prospecting for likely oil-bearing formations.

The earth does not give up its secrets easily and the discovery of petroleum deposits is no exception to this rule. On land, visible surface formations may furnish clues to geophysicists in their operations. In the offshore tidelands, surface formations are covered by both water and recent sediment, making the problem doubly difficult. Geophysicists have found the seismograph to be the most accurate instrument for use in locating possible oil-bearing structures. Currently, it is the principal equipment used to locate such structures and in determining the advisability of risking the "moment of truth" by drilling.

In theory, the Gulf Coast offshore areas, ranging from 10 to 15 miles wide at Brownsville, Texas, to more than 100 miles wide off Louisiana, Mississippi, Alabama, and Florida, are almost all available for lease. Some of the territories have already been leased, in 5,000-acre blocks, but the majority of the areas have not been leased, and for the following reasons.

A tremendous amount of territory has not been explored and little is actually known of its real potential. Besides, titles to the submerged area were clouded when the Federal Government assumed "paramount rights" and control of them several years ago. While the ownership rights have legally and officially been returned to the states by now, the delicate and important question of boundaries has not yet been clarified. This is because the method of determining boundaries both between the various states and the legal limits of state rights from a definite point on land has not been defined by those in authority.

Exploring for Oil-Bearing Formations Under the Sea

As indicated previously, oil companies are now probing at the treasure under the sea, testing wide areas for oil-bearing formations. If a promising structure is found, detailed exploration follows, involving competitive bidding for the lease to the property, followed by long, expensive, and tremendously difficult drilling before a well is brought into profitable production by the successful bidder.

PAYING OUT THE CABLE: After the shot-line markers are anchored and the crews are ready to shoot, the cable and geophones are paid out into the waters of the Gulf from a reel on the stern of the recording boat.

This is a free-enterprise operation and, without the incentive of discovery of a major field, it probably would not have been started at all.

In all probability, complete and thorough descriptions of the entire geological structure of the floor of the Gulf of Mexico, at least to the 600-ft. depth level, will be available at a future date with a resultant gain in knowledge of the geological structure of the coastal shelf, now only surmised, and the pinpointing of all likely oil-bearing formations in the area.

"Salt Domes"

The most eagerly sought structures in the offshore explorations are the heavy-producing "salt domes." Because of the excessively high costs of prospecting and drilling, only such heavily producing structures are considered feasible for drilling operations. However, other structures may also be

ALERTED BY RADIO: After the cable and the geophones have been reeled out and the recording boat has been moved into position parallel to the buoys, the shooting boat is notified by radio to proceed with blasting operations.

oil bearing and are mapped by geophysical science, utilizing the seismograph method.

To date, the majority of these domes have been found in the ancient geological area of Llanoria, which encompassed the states of Arkansas, Oklahoma, Louisiana, eastern Texas, and northeastern Mexico. The exceedingly thick carboniferous formations of the trough, now best seen in Arkansas and southeastern Oklahoma, thicken and become coarser to the south. This indicates that this detritus comes from a mountainous land to the south which had been re-elevated in the late Mississippian time. The old land Llanoria traces its origin probably back to the Cambrian age. American paleogeographers are agreed that, in all probability, it was a large positive mass throughout Paleozoic times. It appears to have been a low land during much of this era. In the latest Mississippian age it began to rise markedly, finally folding into a mountainous area, shedding most of its erosional debris into the Ouachita geosyncline to the north in Arkansas, eastern Oklahoma, and eastern Texas.

As to the mythical boundaries to Llanoria, paleogeographers do not agree because most of it, including the Texas portion of the Ouachita geosyncline, lies buried under the deposits of the Gulf coastal plain and the continental shelf. Apparently, it was not connected with the Appalachia.

At one time, an interior sea lapped upon it in the east, with salt-making lagoons in eastern Texas and southern Louisiana. In the upper Cretaceous age, all of it sank beneath the sea, as is attested by the nature of its various covering formations. From time to time during the Cenozoic age, it continued to subside into the depths. In eastern Texas and southern Louisiana, it is covered by from 7,000 to 25,000 ft. of sediment, indicating the extent to which this portion subsided into the depths of the Gulf.

Llanoria is undoubtedly composed of a series of mountain chains, now buried under the deposits of the Gulf coastal plain and the Gulf itself. Where its formations have wrinkled into salt domes or reefs, oil may have collected from the decomposition or slow distillation of the remains of plant and animal life deposited eons ago in some primeval sea.

Such petroleum deposits may still be where they were formed or may have migrated through porous rock under pressure created by differences in density. They are found in the geological structures known as domes, stratigraphic traps, or reefs.

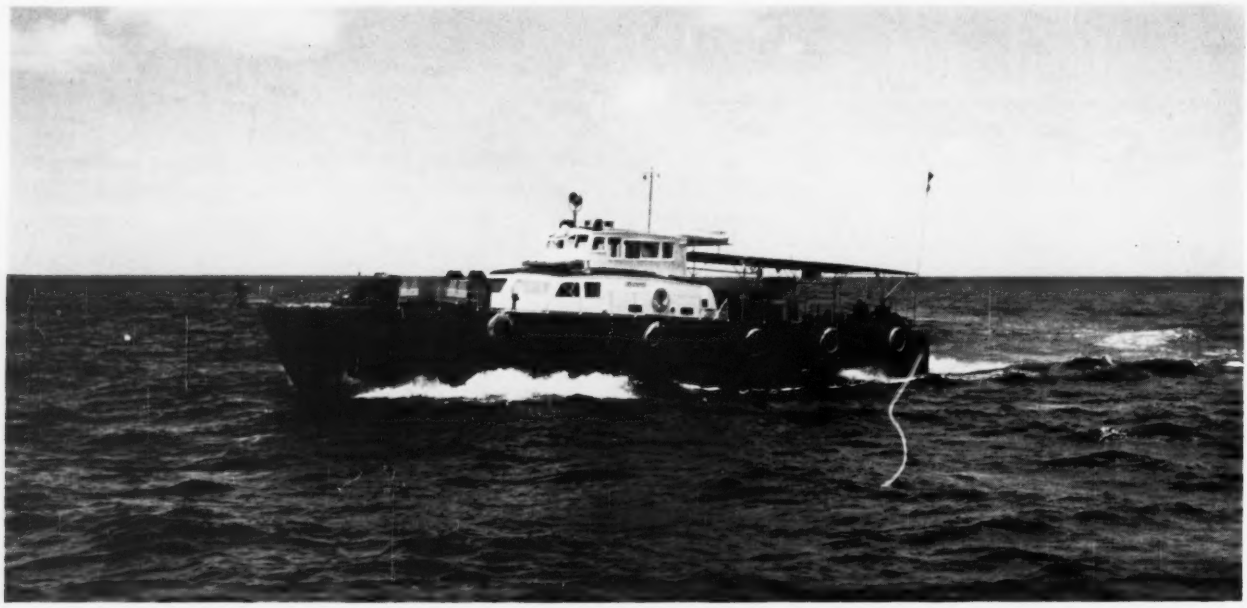
From the exploratory process, the interpreter of seismograph records is able to determine the existence of these "anomalies" in the earth's structure and thus to indicate the possible presence of oil-bearing formations.

An Offshore Geophysical Exploratory Operation

For purposes of simplicity of description, the writer has chosen a simple "offshore" geophysical exploration operation, using the seismographic reflection process and explosives, to explain the mapping of the subsurface land below the water.

The companies which have leased some submerged land and are contemplating developing more when favorable structures are discovered are currently mapping territory off the Gulf coast of Texas. Three converted 85-ft. government-surplus "crash" boats are used in the work, with an additional smaller boat of the same design servicing them with supplies. The boats operate well out of sight of land and they stay there until bad weather conditions drive them in. The boats maintain communication with shore-based installations by radio. The process of exploration is standardized, despite the complications and costs involved.

The areas are first determined by the survey boat, using a land-based tri-



SHOOTING BOAT MOVES UP: The crew on the shooting boat moves it up to a position parallel with the buoy farthest from the recording boat to attend to the details involved in firing charges of explosives.

angulation method. From a known point on land, a survey line is run out to a predetermined marker, then projected on by markers at sea until the desired location is reached. The survey boat then begins laying marker lines. A weight is dropped into the water on a long cord, suspended by a float, and a flag erected at that point. Proceeding on a straight line from the flag point by compass readings, the survey ship drops 20-lb. weights attached to floats and large numbered balloons made of pliofilm at intervals, to form the shot line. While preliminary surveying is accomplished well in advance, the shot-line markers are dropped at the last practical moment to minimize drift from the marked area. The recording and shooting boats are then moved in and the exploratory work is ready to begin.

The land-based mechanical triangulation method used is only one of several methods of fixing locations. Other methods incorporate various applications of radar and electronic methods, utilizing the intersection of radio signals in establishing locations. Each system possesses advantages in specific situations. In reasonably close-in "jumping" operations such as those now being conducted, the mechanical method possesses the advantages of simplicity, economy, and flexibility.

The survey boat follows a predetermined search pattern until an interesting trend is discovered from the seismographic records. The structure is then mapped in increasing and intensive detail. The width of the area covered between shot lines varies from time to time. In general, the first tests are made with the detonation of charges of explosives set off at regular intervals, with parallel line tests made some distance away. Should favorable structures be discovered, or if company policy indicates a more intensive search in the area, the distance between the parallel shot lines is halved, then subdivided repeatedly until a complete record is available.

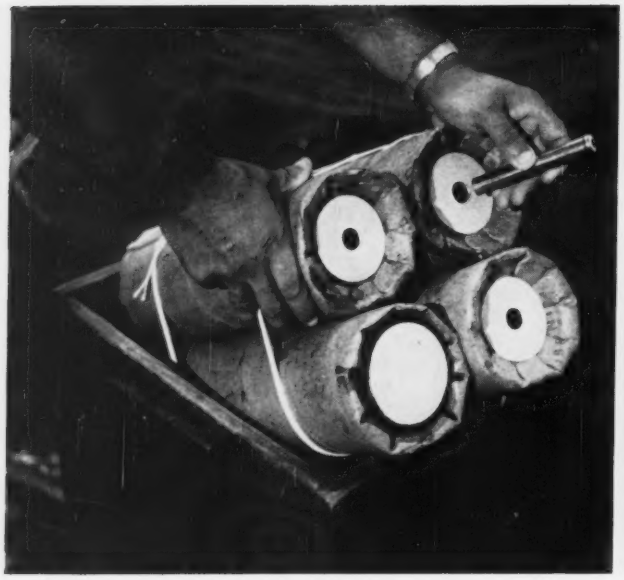
Getting Ready to Shoot A Charge of Explosives Underwater

When the boats are ready to shoot (fire charges of explosives), the recording boat pays out the submarine cable containing the geophones from a reel on the stern. When the recording boat has finished reeling out the cable and is in a position parallel to the buoys previously laid out by the survey boat, and with the boat anchor on the bottom and line tension slacked off to avoid drift, the shooting of explosives charges is ready to begin. The shooting boat is notified by radio and moves into position at the buoy farthest from the recording boat. Usually two shots are fired.

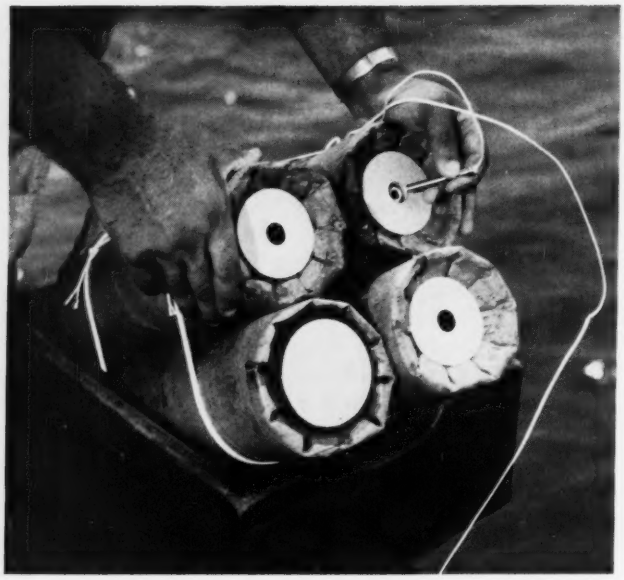
On the shooting boat, the shooter has laid out from 10 to 15 cases of Vibronite®-B. Vibronite-B is a nitro carbo nitrate blasting agent packed into 5-in. by 10-lb. and 8-in. by 40-lb. water-resistant containers. Vibronite-B was

PREPARING TO SHOOT: Fiber cases of Vibronite-B are brought up from the magazine in the hold and opened on the deck of the shooting boat. Vibronite-B is a nitro carbo nitrate blasting agent packed in water-resistant containers especially designed for underwater shooting of this type by Hercules Powder Company.

MAKING UP CHARGES: Deck hands tie together four 5-in. by 10-lb. containers of Vibronite-B to make individual 40-lb. charges. A large balloon made of pliofilm is fastened securely to each charge to hold the explosives in suspension 5 ft. below the surface of the water.



THE TITAN BOOSTER 20: A close-up of the Titan Booster 20, the priming agent for charges of Vibronite-B. A copper well is centered in one end of a Vibronite-B container. An indentation on the side wall of the well holds the booster firmly in place.



AN SR VIBROCAP: After the Titan Booster is seated, an SR Vibrocap is inserted into a copper well in one end of the shell of the booster. The firing of the Vibrocap detonates the booster charge which, in turn, detonates the charge of Vibronite-B.

DROPPING A CHARGE: After a 40-lb. charge of the explosives has been primed and the leg wires of the SR Vibrocap are connected to the firing cable, the assistant shooter drops the explosives overboard and the shooting boat draws away from the area.

especially developed and manufactured by Hercules Powder Company for this type of underwater shooting. Its insensitivity contributes to greater safety in the confined areas on boats where explosives materials must be stored. The design and construction of the containers are such that they disintegrate after being immersed in water for a period of hours and their nitro carbo nitrate contents are destroyed and are no longer explosive. Thus this unique blasting agent does not become a menace to navigation or to continued exploratory operations.

Titan® Booster 20, also designed and manufactured by Hercules Powder Company, is used as the priming agent for Vibronite-B. A copper well of a size sufficient to hold the Titan Booster is centered in one end of a Vibronite-B container. When the booster is inserted and pushed to the bottom of this well, an indentation on the side wall of the copper well engages and holds it firmly in place. The Titan Booster consists of a copper shell ⅝ in. in diameter and 4½ in. in length. In one end of the shell there is a copper well into which a Hercules SR Vibrocap® is inserted as a primer for the Titan Booster. An indentation in the side wall of the well holds the Vibrocap in place and prevents its being pulled away from the booster.

The introduction of the Titan Booster 20 provided another important factor of safety in the handling and storage of explosives on boats used in offshore prospecting activities. The boosters and the Vibrocap detonators are stored separately at the far end of the shooting boats, away from the blasting decks, until it is time to prime the explosives charges and fire shots. The above procedure is standard practice with all of the crews.

FIRING THE CHARGE: When the shooting boat reaches a distance of approximately 300 ft. from the submerged charge, the shooter notifies the recording boat by radio and pushes down the plunger of the blasting machine to detonate the charge.

Shooting a 40-lb. Charge Of Vibronite-B

The shooter's assistant places a charge of Vibronite-B, made up of four 5-in. by 10-lb. containers, on a small deck at the rear of the shooting boat and the skipper of the craft maneuvers the boat into position near the shot line. A balloon is tied to the 40-lb. charge, and a Titan Booster 20 and an SR Vibrocap are inserted. The leg wires of the Vibrocap are connected to a 500-ft. duplex rubber-insulated firing cable attached to a blasting machine which delivers adequate voltage to detonate the Vibrocap. After the shooter has inserted the booster and cap, his assistant drops the charge overboard, and the shooting boat draws away. When it reaches an approximate distance of 300 ft., the charge suspended 5 ft. below the surface of the water by the balloon is exploded and a column of water leaps several hundred feet into the air. The foregoing operating details are repeated until the line has been explored.

On the recording boat, the observer has been in constant radio communication with the shooter and records each shot as it is fired.

The detonation of the explosives charge sends energy impulses down through the water and the overlaying layer of sedimentation to the rock formations below. The different strata vary characteristically in their elasticity and resistance to sound waves. As the impulses strike them and return, the time elapsed is measured in intervals up to 1/1000 of a second. This "travel time" is the unit of measurement that indicates to the geophysicist the depth of the formations below and points up the "anomalies" for which he is looking. In this particular operation, the readings included depths to 18,000 ft., through several thousand feet of sediment to the structures in which oil might possibly be found.

Recording the Depths Of Subsurface Formations

The returning impulses, which are transferred to the recording machine

(Continued on page 152)

NOVA SCOTIA'S UNIQUE HIGHWAY: With approximately 2,000,000 tons of rock fill in place, a section of the Canso Causeway juts out from the mainland of Nova Scotia into the waters of the Strait of Canso.

CONSTRUCTING A MODERN HIGHWAY ACROSS THE STRAIT OF CANSO

Nova Scotia and Cape Breton Island, separated by the waters of the 3,600-ft.-wide Strait of Canso, will soon be joined by one of the world's most unique highways

DENNIS PELRINE*

(Photographs by Gene Mattatall)

For several years, the question of how to effect a connecting link between the mainland of Nova Scotia and Cape Breton Island, separated by the waters of the 3,600-ft.-wide Strait of Canso, was a political football. The relative merits of a bridge or a tunnel were explored in many heated discussions and arguments. When, in the spring of 1952, the Department of Transport announced that it would receive bids for the construction of a causeway across the Strait, to be known as the Canso Causeway, Nova Scotians were amazed. Most of them thought such a solution of the problem was highly impractical, if not impossible. However, in due course, bids were received and a contract to do the work was awarded to the firm of Northern Construction Company and J. W. Stewart Limited, of Vancouver, British Columbia, on its bid of $22,000,000.

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Dartmouth
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At the time of the writer's visit in May, 1953, less than a year had elapsed since the first load of blasted rock had been dumped into the Strait. With some skeptics still mumbling "it can't be done," the work of constructing the causeway had been pushed to one-quarter of its eventual length. According to officials of the contracting firm at the site, another 12 to 18 months should suffice to complete the project.

Along the shore of the Strait, ½ mile from the site of the project, is a huge deposit of granite, andesite, and rhyolite called Porcupine Hill and referred to locally as "Big Porky." The maximum height of this hard rock formation is 600 ft. The rock required as fill material in the construction of the causeway is obtained by the contractor's crews from blasting with dynamite loaded into coyote holes or tunnels, drilled into the side of the hill.

Blasting Tunnels in Porcupine Hill

A typical primary blast on the project, using the tunnel method, involves the following procedure. An entrance tunnel, approximately 4 ft. wide and 5 ft. high, is driven vertically into the rock at the base of the hill for a distance of about 50 ft. Then, two tunnels are driven at right angles to the

entrance tunnel, parallel to the face of the hill, each about 40 ft. long. Charges of dynamite are loaded into the extreme ends of the two cross tunnels. The charges are backfilled with stemming for approximately one-half the distance of each cross tunnel, after which a second charge of dynamite is loaded and backfilled with stemming. In some instances, an additional charge of dynamite is loaded at the junction of the cross tunnel and the entrance tunnel. As indicated above, stemming is used between all charges and in the entrance tunnel to a location near the portal. Each dynamite charge is primed with a short-period delay electric blasting cap and the blast is fired by means of a 220-volt power line.

The dynamite used by the contractor is a 40% ammonia type, packed in 12½-lb. bags. The amounts loaded for individual blasts are varied to fit existing conditions. In some of the larger blasts the charges loaded total 20,000 lbs; for the smaller ones, the average loaded totaled about 3,000 lbs. of dynamite.

Excavating Rock for Fill

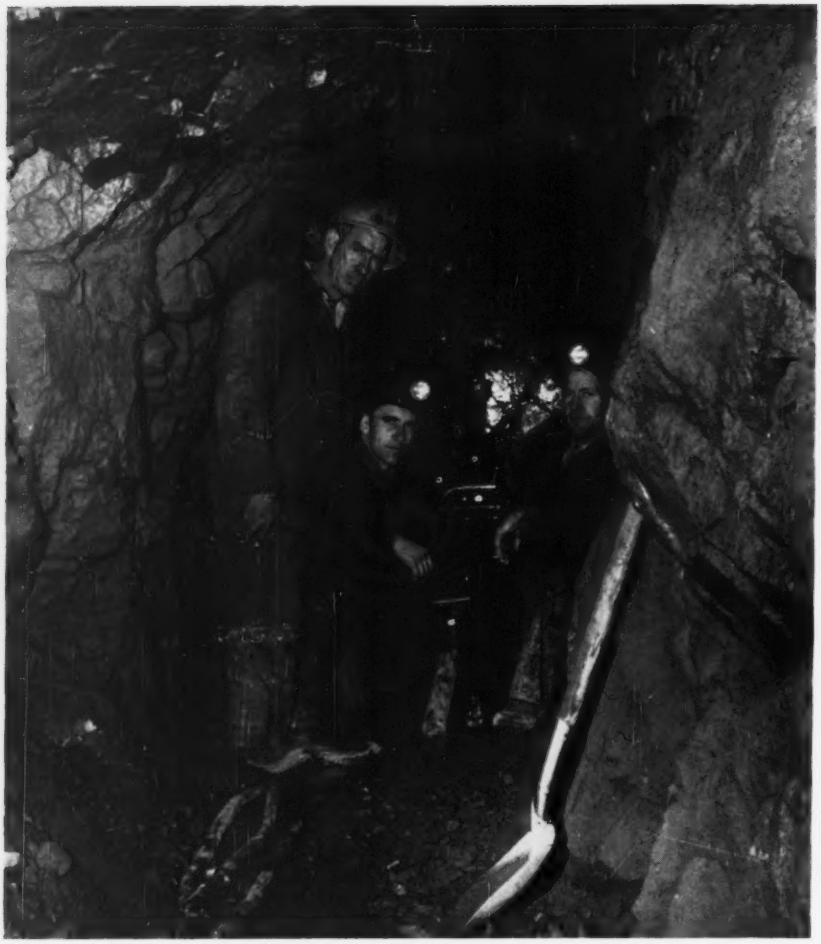
The detonation of the tunnel blasts causes the fractured rock to roll down the slope of the hill and pile up onto the working floors. Two Bucyrus-Erie 120-B electric shovels with 6-cu. yd. dippers load out the blasted rock into 34-ton FFD Euclid trucks for hauling to the project site. During the trips to the causeway, the truckloads of rock are weighed on 100-ton-capacity Howe scales. Upon arrival at the job location, the rock is dumped and TD-24 International bulldozers push it into the Strait. More than 2,000,000 tons of blasted rock had been put into place on the highway site by this method up to the middle of April, 1953.

Copco drills are employed exclusively on this project, both the Coromant Series 4 and the Model RH-656-4W, equipped with BMK-61-A2 pushers cut down to 36 in.

While some of the electricity used for power purposes on the job is provided by local firms, an additional supply is generated at the site by means of two Caterpillar D397 electric generator sets and a Chicago Pneumatic 250-kw. electric generator. The equipment at the job location supplies all of the power required for the operation of the electric shovels and other incidental purposes. With work going on continuously in three 8-hour shifts, power is one of the big items on this project. During the hours of dusk and darkness, the entire area is floodlighted. Frequent fogs and heavy mists in the area require the use of floodlights at working places during many daylight hours.

One of the difficult problems encountered by the contractor has been caused by heavy ice floes that pass through the Strait from northern ice fields during the early spring months. Swept along by the swirling current, huge mounds of ice were piled up against completed sections of the

"BIG PORKY": Broken rock required as fill material in the construction of the new causeway is obtained by the contractor from tunnel blasts in a huge deposit of granite, known locally as "Big Porky."



IN A TUNNEL: Tunnels 50 ft. deep, with two 40-ft. lateral wings, are driven into the side of Big Porky by the drilling crew. Blasts are made with a 40% ammonia-type dynamite packed in 12½-lb. bags and primed with short-period delay electric blasting caps.

causeway. While they did no damage to structures, they slowed up work considerably on several occasions.

A 4,300-ft. Causeway

Considered to be one of the most ambitious undertakings in the history of causeway construction, the Canso project will measure 4,300 ft. on the completion of its span across the 3,600-ft. Strait. The extra length is accounted for by a pronounced curve near both ends of the job.

The maximum depth of the water along the center line of the causeway is 187 ft., under which lies an additional 25 ft. of silt. When completed, the top of the roadway will have a width of 80 ft. and a base width of approximately 600 ft. The surface will be 20 ft. above low water and 13 ft. above high water.

In May of this year, the project reached its most difficult phase, that of placing the fill in water 212 ft. deep, including the silt base. With this part of the job completed, the contractor's crews are continuing a steady advance in bringing the causeway toward the Cape Breton shore. Work has already begun at the latter location on the construction of a navigation lock. This work is being done by T. C. Gorman Construction Company of Halifax, Nova Scotia.

AFTER A TUNNEL BLAST: A Bucyrus-Erie 120-B electric shovel with a 6-cu. yd. dipper loads out broken rock after a tunnel blast into a 34-ton Euclid truck for transportation to the project.

AT THE WEIGHING STATION: Ten Euclid trucks, like the one pictured above at the weighing station, will haul a total of 9,000,000 tons of blasted rock to the project before the job is completed.

The Completed Project

The finished project will include a two-lane highway and a railway line on one side of the surface. At present, the industrial area of Cape Breton Island, housing eastern Canada's biggest steel- and coal-production facilities, is dependent on a train ferry to move its products inland. After the job is completed, the economy of Cape Breton will receive a definite boost, with both highway and rail transportation available in an unbroken line for the first time in the long history of the Island.

The successful completion of this difficult project will constitute personal achievements for the men who will have made Canadian, if not world, history in their field. The top men on this venture include W. M. "Bill" Goodwin, project manager; Gus Vinblad, superintendent; Doug Lambert, project engineer; M. Osadan, and J. Shannon, night bosses.

All that remains to complete the project is for "Big Porky" to contribute another 7,000,000 tons of rock for fill, causing the Canso Causeway to be entered in the record books as another big construction job well done.

CONTRACTOR'S KEY MEN: Operating supervisors for the contractor on this big job in Nova Scotia are, left to right, Bill Goodwin, project manager; D. Gow, office manager; Doug Lambert, project engineer; and Gus Vinblad, project superintendent.

SPREADING ROCK FILL: One of the TD-24 International bulldozers pushes broken rock into the Strait as fill. The open end of the causeway is directly opposite the source of rock supply, Big Porky, looming up in the background.

HUNTER TUNNEL MINERS AWARDED SENTINELS of SAFETY TROPHY

Employes of The Philadelphia and Reading Coal and Iron Company's anthracite mine at Ashland, Pennsylvania, are honored for a perfect safety record in 1952, involving 77,336 man-hours of work underground

On Saturday, August 8, 1953, at 10 o'clock in the morning, a program of interesting events, under the auspices of The Philadelphia and Reading Coal and Iron Company, got under way in Lakewood Park Pavilion near Pottsville, Pennsylvania. The occasion marked the 49th anniversary of P and R's first-aid contests among teams from the company's active operations, and the presentation of awards to employes of various mining units for outstanding achievements in safety.

In addition to the more than 800 employes present, district and local officers of the United Mine Workers of America, representatives of the U. S. Bureau of Mines, of the Pennsylvania Department of Mines, and of the School of Mineral Industries of Pennsylvania State College, and officials of neighboring anthracite-producing companies attended the ceremonies.

Following the singing of the national anthem and a welcoming address by the master of ceremonies, George J. Clark, general manager of the P and R company, the program began with the working of three contest problems by well-trained first-aid teams representing eight of the coal company's mining properties. St. Nicholas Central Breaker was the winner with a percentage of 99.416; Locust Summit Central Breaker was second with 99.300; and Potts Colliery was third with 99.166. George A. Roos, company vice president, presented prizes to the members of the winning teams.

AWARDING TROPHY AND FLAG: After extending congratulations to the Hunter Tunnel mine employes for their perfect safety record during 77,336 man-hours of work in 1952, Joseph I. Horty, left, editor of The Explosives Engineer, awards the Sentinels of Safety trophy and flag to Clarence O. Whaite, the superintendent of Hunter Tunnel mine.

JOSEPH A. HOLMES CERTIFICATE: John J. Forbes, right, director of the U. S. Bureau of Mines, presents a Joseph A. Holmes Safety Association Certificate to Edward D. Williams, superintendent of P and R coal company's Locust Summit Breaker, and William J. Whalen, president of Local Union 876, United Mine Workers of America.

After being introduced by the master of ceremonies, the director of the U. S. Bureau of Mines, John J. Forbes, presented the Joseph A. Holmes Safety Association Certificates of Honor to five of the company's operating units—Locust Summit Breaker, Oak Hill Mine, Newkirk Mine, Maple Hill Colliery, and Shen-Penn Production Company—for records of nonfatal injuries during long periods of work. In presenting the certificates, Mr. Forbes commended the personnel at these five operations for having mined and prepared 27,035,767 tons of anthracite during a total worktime of 16,358,815 man-hours of exposure without incurring a fatality. An individual award was presented by Mr. Forbes to Leon H. Strecker, outside foreman at Alaska Colliery, "for supervising surface employes from July 14, 1948, to October 3, 1952, with no disabling injuries during a total worktime of 458,588 man-hours."

FIRST-AID TEAMS: Trained teams, representing eight operating properties of The Philadelphia and Reading Coal and Iron Company, at work on one of three complicated first-aid problems before the eyes of expert judges.

PRIZES TO THE WINNERS: George A. Roos, vice president, The Philadelphia and Reading Coal and Iron Company, right, presents prizes to the members of the winning first-aid team representing the St. Nicholas Central Breaker.

Cooperation Pays Dividends

After the presentation of the certificates, Mr. Clark introduced Joseph I. Horty, editor of THE EXPLOSIVES ENGINEER, to make the awards of the Sentinels of Safety trophy and flag to Clarence O. Whaite, superintendent of Hunter Tunnel mine, representing the mine employes. During his talk, Mr. Horty commented that 51 mines had been enrolled in the anthracite group in the National Safety Competition of 1952. "When the records were tabulated, the total worktime of 77,336 man-hours with no lost-time injuries at Hunter Tunnel mine was the best record in that group." In conclusion, Mr. Horty said, "During your seven years of participation in this nationwide safety contest, Hunter Tunnel mine won a Certificate of Achievement in Safety in 1946; it won the Sentinels of Safety trophy and flag in the 1948 competition; and it won the trophy and flag again in the 1952 competition. Through the years, your records point clearly to the fact that every man has a feeling of personal responsibility to live up to the rules and regulations of your company's safety program. That kind of cooperation pays dividends in health and happiness for you, your families, and your friends."

Mr. Forbes presented individual Certificates of Achievement in Safety to Mr. Whaite for later distribution to each employe in the Hunter Tunnel mine organization.

In accepting the Sentinels of Safety awards and the certificates, Superintendent Whaite expressed his pride, and the pride of each of his fellow-workmen, on being the winners in this national competition for safety honors. "We will continue to do our best to eliminate lost-time accidents," he said, "and we look forward to winning the trophy, the flag, and individual certificates many more times in the future."

At the conclusion of Mr. Whaite's remarks, Gordon E. Smith, representing the Pennsylvania Department of Mines, extended congratulations to the employes and officials of the P & R company for their sustained efforts in the promotion and development of safe working conditions in all phases of underground and surface operations.

The program was brought to a close with an invitation to everyone present to partake of a buffet luncheon, with the compliments of The Philadelphia and Reading Coal and Iron Company.

LET THERE BE LIGHT

CHARLES F. THOMAS*

The old Davy lamp served well in its day,
To dimly, yet safely, light gloom
In dark labyrinths, where miners dug coal
In entry, tight crosscut, and room.
With ears sharply tuned to whispering sounds
From squeezing wedge, pillar, or frame;
Eyes weary, read signs of dangers that lurked
And dimmed the lamp's flickering flame.

From olden bowl's flames came brighter oil lamps,
With spouts like the housewife's teapots,
And tight, twisted wicks with short, stinking flames,
Paths lighted in underground spots.
While greasy, begrimed, they hung on men's caps,
O'er faces as grimy and soiled
As faces of coal at pillars or rooms
Where miners so wearily toiled.

To miners who worked in old Camp Bird's depths,
Four candles were doled for each shift,
And each burned its hours in candlestick's clamp
In stope, up the raise or the drift.
While "snuffs," the short ends of lights nearly spent,
Were picked, like rare gems, from the ground,
And added rich moments of safety and light,
When spitting the fuse in a round.

Again came a day when chemistry's art
Schemed well to make mine work more bright;
In elements mixed with scientist's skill—
Add water – to carbide – then light.
But as with all lights that ever have failed,
Resourceful man needed to be,
To plan his supply – but in need to call
On Nature in adversity!

With batteries clipped to miners' snug belts,
And cables hooked up to their lamps,
Bright light pierced the dark, like Cyclopean eye,
Through perils of mines' sneaking damps.
No searching for carbide, water, or wire,
Or oil that was spilled by a blast;
A wizard, with dreamers, workers, and power,
Made mine workings safer at last.

And tunnels today, where hardrockers toil,
Are as light as a welcoming door;
The drill jumbos gleam, lit like a big church,
From "Christmas Tree" down to the floor.
Sharp, flashing lights warn when danger is near—
Loosed rock from a starter steel's shock,
And mining keeps pace as lights brighter shine—
More tunnels! More powder! More rock!

*Box 1017, Ephrata, Washington

DRILLING BLAST HOLES: Gardner-Denver wagon drills were used to put down vertical blast holes 20 ft. deep on 6-ft. staggered spacings into the working faces of the quarry.

QUARRYING

A MASSIVE GRANITE FORMATION IN VIRGINIA

Drilling and blasting on benches with working faces 20 ft. high produced excellent fragmentation with a minimum of backbreak and fly rock

R. W. McCALL*

THE John H. Kerr Dam, originally designated Buggs Island Dam, located near South Hill in Mecklenburg County, Virginia, is the first major project to be completed in the U. S. Army Corps of Engineer's extensive construction program designed to control floods and to generate electric power for the benefit of residents of the Roanoke River Valley. All construction details involved in the Roanoke River program are under the direction of the district engineer of the Corps and his staff, with headquarters in Norfolk, Virginia.

The Kerr Dam, a 2,785-ft.-long concrete structure of the gravity type, is flanked by an earth wing and saddle dikes that make its overall length 19,250 ft. The maximum height of the concrete structure is 144 ft.; the earth

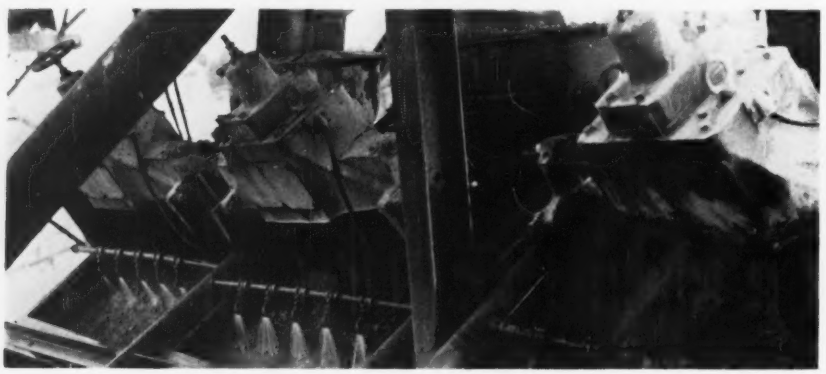
*Manager, Ralph E. Mills and Gorman Brothers, Inc. South Hill, Virginia

EXCELLENT FRAGMENTATION: The use of short-period delay electric blasting caps as the detonators of the dynamite charges in primary blasts contributed to excellent fragmentation and the minimizing of backbreak and fly rock.

wing and saddle dikes on each side measure 45 ft. in height.

The specifications for the concrete required for the construction of the dam and powerhouse stipulated 650,000 cu. yds. Crushed stone requirements for use as concrete aggregate, riprap, blanket material, railroad ballast, the relocation of roadways and structures, and the manufacture of sand were awarded by contract to Ralph E. Mills and Gorman Brothers of Flemingsburg, Kentucky, a combination of quarry and heavy-construction specialists with long and varied experiences.

The quarry selected by the Mills and Gorman organization to produce the crushed stone requirements in its contract is located on property which had been leased previously to the Government by Southern Aggregates Corporation. The quarry had been opened by Lambert Brothers, Incorporated, of Knoxville, Tennessee, to supply crushed stone for a Government-built highway and railroad. When the Mills and Gorman crews moved onto the property, they found the formation in the quarry to be partially exposed, and only a minimum of stripping and the removal of weathered rock were necessary.



SAND MANUFACTURE: A close-up of some of the smaller sizes of crushed stone being processed through a wet screening operation in the plant for the manufacture of sand required on the project. Fines over 100 mesh are wasted.

The Rock in the Quarry

The rock formation in the quarry is a massive granite almost devoid of natural bedding planes and fissures. Petrographic analyses of its mineral composition revealed it to be 30 per cent quartz, 24.2 per cent microcline, 39.4 per cent plagioclase, and 6.5 per cent mica.

The contractor's plan of operations was to develop a high working face and to use the well-drill method of drilling and blasting. Trials of this method resulted in unsatisfactory progress and a change to the bench method was made with more satisfactory results. The height of the working faces of the benches was established at approximately 20 ft. Because of the lack of bedding planes and fissures, difficulty was experienced in maintaining uniform grades at the floor levels of the benches. This problem was overcome by the exercise of special vigilance by the drilling crews in maintaining uniformity in the depths and spacings of the drill holes.

Drills and Compressors

Gardner-Denver Model D99DT wagon drills and S55 jackhammers were employed in the drilling operations. The wagon drills were equipped with 1¼-in. round steel in 6 to 24-ft. lengths, and 2¼ and 2-in. detachable carbide chisel-type bits. The jackhammers were equipped with Hex. steel in 2 to 10-ft. lengths, and 1¾-in. detachable bits. Air for the drills was supplied from a stationary plant consisting of two compressors, a 1,700-c.f.m. OCE Chicago Pneumatic and a 1,070-c.f.m. XRE Ingersoll-Rand. The compressed air was delivered to the drills through a 6-in. line, providing uniform pressure at the drills.

Abnormal abrasion was encountered in drilling operations and two complete sets of steel and bits were maintained for each drill at all times. This minimized delays and provided ample time for the steel to cool. The wagon-drill crews averaged 300 ft. of hole per drill per eight-hour shift; the bits averaged about 250 ft.

A Typical Blast

A typical primary blast in the quarry involved a section of a bench 75 by 250 ft., with the narrow end utilized as the working face. Holes for blasting were drilled 20 ft. deep, with staggered spacings on a 5½ by 6-ft. pattern. Each hole was loaded with 60% ammonia gelatin dynamite in the bottom and 40% ammonia gelatin dynamite on top of the bottom charge. The loading ratio was 1 lb. of dynamite to 3.3 tons of rock in the solid. Short-period delay electric blasting caps, from first through sixth delay periods, were used as primers for the dynamite charges. Approximately 1½ ft. of moist sand was tamped on top of the explosives to stem each hole to the collar. After loading operations were completed, the leg wires of the caps were connected in series parallel, 20 caps to a series, and the blast was fired with a 440-volt electric current. Excellent fragmentation resulted from this plan of blasting, and backbreak and fly rock were practically eliminated. Secondary blasting was negligible.

The banks of blasted rock in the quarry were recovered by two Diesel-powered shovels, a 2½-cu. yd. 54B Bucyrus-Erie and a 1½-cu. yd. 605 Koehring, and loaded into a fleet of six WD-60 Koehring dumptors for transportation to the primary crusher at the plant. From March, 1949, to March, 1952, the crushing plant produced approximately 2,000,000 tons of various sizes of stone. Of this total, about 1,400,000 tons were delivered to various project locations in railroad cars, and 600,000 tons in trucks.

RECOVERING BLASTED ROCK: After one of the primary blasts had been fired, a Bucyrus-Erie Diesel-powered shovel is put to work to load the broken rock into a Koehring dumptor for delivery to the primary crusher at the plant.

Safety, Equipment, Personnel

Safety in operations was of prime importance and everyone cooperated in complying with the regulations established by the contractor and the Army Engineers. No lost-time accidents were experienced in conducting the blasting operations in the quarry. In addition to furnishing safety equipment to the men on the job — helmets, shoes, goggles, and respirators—quarry and plant supervisors, supplemented by representatives of insurance companies, conducted meetings at regular intervals, at which all the employes participated in discussions of possible hazards and how to eliminate them.

The officers of the contracting firm comprised Ralph E. Mills, president; A. D. Gorman, vice president; C. E. Gorman, treasurer; and C. W. Wood, secretary. The supervising personnel at the quarry and plant on the Virginia project included R. W. McCall, manager; J. W. Wilkins, quarry superintendent; M. D. Sadler, plant superintendent; James Neuman, plant foreman; C. W. Shumaker, master mechanic; J. B. Call, office manager; and Ethel G. Cooper, secretary.

OPERATING PERSONNEL: Left to right, R. W. McCall, manager; J. B. Call, office manager; J. W. Wilkins, quarry superintendent; C. W. Shumaker, master mechanic; Ethel G. Cooper, secretary; J. S. Neuman, plant foreman; M. D. Sadler, plant superintendent.

Shooting for Oil in the Gulf of Mexico

(Continued from page 141)

by the geophones, are sent through a "mixing board" before being recorded. Overlapping impulses are mixed to reinforce the weak ones and bring the stronger ones down, in order to stabilize the picture.

The amplified signals pass through the mixer into the galvanometers. The power from the electronic signal is converted into mechanical movement by an oscillating coil in a magnetic field and thus drives a moving light beam which is directed upon light-sensitized paper through a mirror. The picture drawn by the light beam makes a wavering black line when the paper is developed. The 20 beams from the 20 geophones as recorded are used to determine the depths to the formations below. Where excessive abnormalities and depth variations are noted, the sought-for salt dome, structure, or stratigraphic trap is indicated.

The seismographic record, while indicative to the geophysicist, does not, of course, tell the whole story. The record is taken back to headquarters, plotted on cross sections by trained interpreters, and the resulting maps give a specific reflecting horizon. The computing process, involving thousands of separate calculations, is then checked carefully for accuracy, and becomes the basis for the company's decision as to whether to risk, first, the lease, and, then, the millions of dollars necessary to sink a well in deep water out of sight of land, with the resulting production problems.

The cost of submarine seismograph work is high. Aside from the original expenditures such as $25,000 for the cable, and thousands upon thousands of dollars for other mechanical equipment, the operating cost of a three-boat crew engaged in such work may be in excess of $50,000 a month.

RECORDING ENERGY IMPULSES: As the energy impulses from the explosion strike the submerged strata and return, the time elapsed is measured in intervals up to 1/1000 of a second. This travel time indicates to the geophysicist the depth of the submerged strata.

Weather Big Factor In Offshore Activities

The amount of territory covered by an offshore exploratory crew is extremely variable, for its activities are at the mercy of weather conditions. Sometimes crews may be idle for weeks at a time; at other times they may work steadily. When an operation is started it is continuous, including Sundays and holidays, whenever shooting is practical. The size of areas surveyed is also dependent upon the thoroughness of the operation.

Despite mechanical failures, bad weather conditions, and other operating difficulties, an offshore seismograph crew will often cover as much territory in a month as a land crew will cover in several months. It is difficult to establish an average number of line shots in a month, or the territory covered. Some crews have made as many as 4,000 shots in one month; others operate at an average of less than 1,000.

The total square feet of area covered will vary with the distance between the shot lines on the grid as the necessity of close examination of specific structural conditions dictates.

What the present seismographic activity on the Gulf Coast will mean in the future is unknown. One certain fact is that the presence or absence of

THE PARTY CHIEF: The geophysical crew's party chief examines a map of the offshore area in the Gulf of Mexico where preliminary prospecting activities are now in progress.

THE SUPPLY BOAT: The exploration crew, working its way up and down the coastal shelf of the Gulf of Mexico, is kept supplied with a variety of materials and equipment by a converted government-surplus "crash" boat.

typical oil-bearing structures will be established over a wide area by oil companies' seismic prospecting crews using explosives and specialized equipment, provided tideland titles are cleared. Currently, leases granted by the states are expensive. One 13,750-acre tract within the Louisiana jurisdiction was leased recently by a major oil company for $533,000. That payment was only the initial one, granting the right to drill. If oil is discovered, additional amounts of money will be paid to the state for rentals and for royalties on the oil realized.

Exploration and Production Costs Exceed $260,000,000

To date, the major discoveries of offshore oil have been made off the coast of Louisiana, and no oil has been found off the Texas coast. Of a total of 211 holes drilled offshore up to July, 1953, 105 found oil and 5 found gas. Sixteen of the dry holes drilled were in Texas. The total production from offshore sources is currently about 12,000 barrels of oil and 50 to 100 million cu. ft. of gas a day. For this return, expenditures for exploration and production total more than $260,000,000.

Geologists are reluctant to hazard speculations on whether or not the Texas coast will ever produce very much oil. Some, however, are optimistic. Under any circumstances, seismographic exploration activity using explosives in the Gulf may be expected to continue for several years, until the entire area is mapped.

Currently, drilling operations are limited to shallow depths in water approximately 60 ft. deep. Future development techniques, however, may make it possible to go to the limit of the 600-ft. depth of the continental shelf, from where it drops off into the oceanic abyss of the Gulf.

MORE THAN A BOOK

A COMPLETE SYSTEM

ESTIMATE CONSTRUCTION COSTS WITH SAFETY

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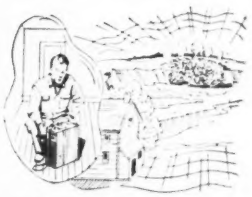

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News Notes

DIESEL ENGINE

A new, unique, and informative booklet on Diesel engines, written in simple, non-technical language, has been published by the P&H Diesel Division, Harnischfeger Corporation.

Entitled *What You Should Know About Diesel Engines,* it effectively calls upon the grade-school "primer" technique for both telling and illustrating the Diesel story. The booklet records the Diesel engine's invention and early development; compares it with the gasoline engine; tells about 2-cycle and 4-cycle types of Diesels; explains operation of Diesel engines in simple pictures and words; and reports latest advancements in modern Diesel engine design.

The new two-color booklet, handy pocket size, will be mailed on request. Address P&H Diesel Division, Harnischfeger Corporation, Crystal Lake, Ill.

POWER CRANES AND SHOVELS

A series of eight articles discussing the use and application of power cranes and shovels has been compiled under one cover by the Koehring Company of Milwaukee, and made available for general distribution.

As indicated by the title, *Power Cranes and Shovels,* the 32-page booklet contains a detailed discussion on the basic principles of power shovel and crane operation. Aided by numerous photographs, drawings, graphs, and tables, the capabilities of various excavator and crane attachments are outlined, along with prescribed requirements for the most efficient operation of the machines. The details involved in making a proper selection of this equipment for ordinary operating situations also are discussed in detail.

Two complete articles in the booklet are devoted to a discussion of safety considerations with excavators and excavator operating costs, thus making the booklet a handy reference manual for owners and operators as well as a text for engineering students.

Booklets may be obtained from any Koehring distributor or by communicating direct with the Koehring Company, 3026 West Concordia Avenue, Milwaukee 16, Wis.

AIR-LEG ROCK DRILL

An air-leg rock-drill combination designed as a completely integrated unit is being offered by Ingersoll-Rand Company. Known as the JR-38 Jackdrill, it has features not available in Jackhamer air-leg combinations. The most radical innovation is a built-in air coupling between the drill and the feed leg, doing away with the third hose necessary in previous combinations.

The JR-38 Jackdrill can be used as a drifter, stopehammer, or jackhammer. For jackhammer use, the feed leg is detached from the drill by simply loosening the coupling nut, and is ready for use without any further adjustment.

For additional information, contact any of the many Ingersoll-Rand branch offices located throughout the country or write to Ingersoll-Rand Company, Dept. RD, 11 Broadway, New York 4, N. Y.

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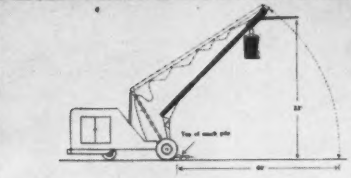

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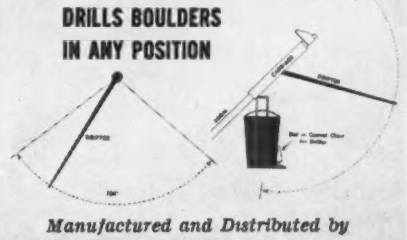

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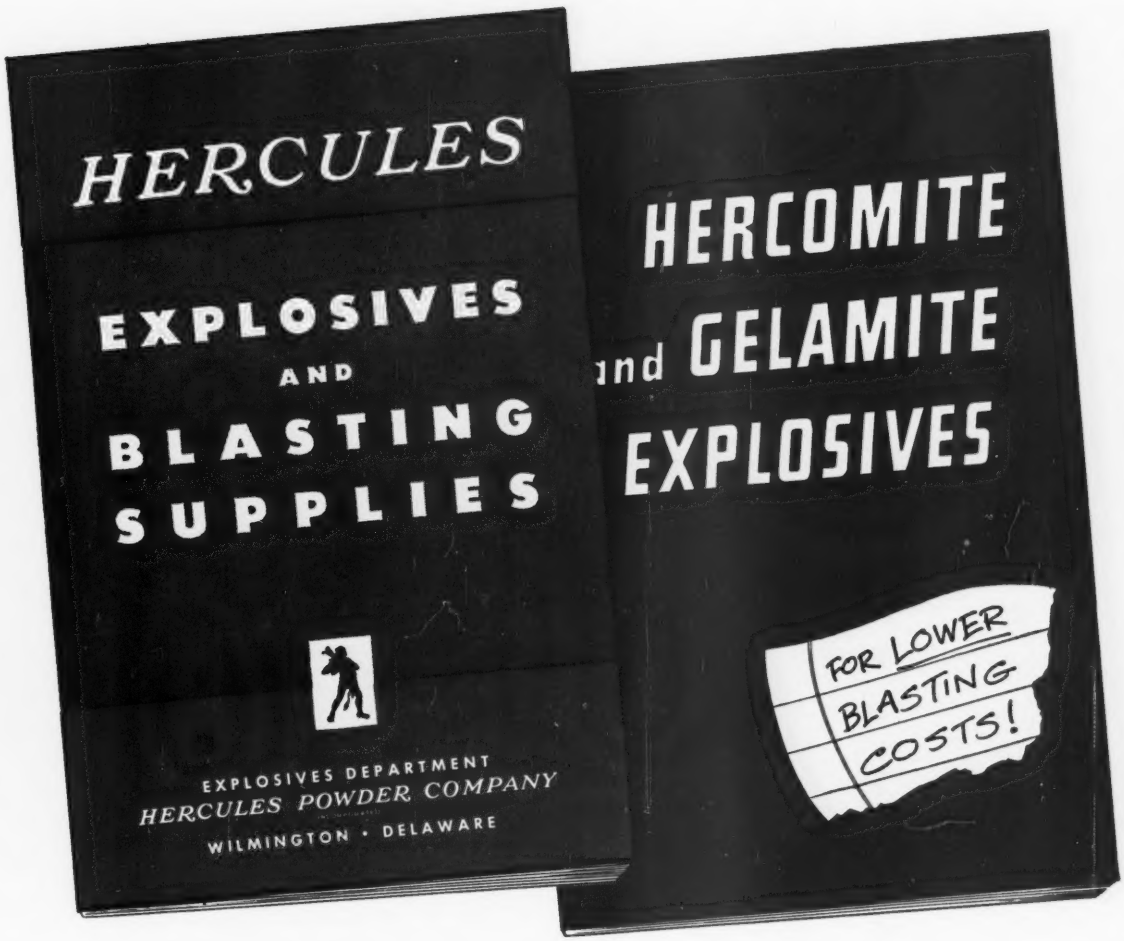

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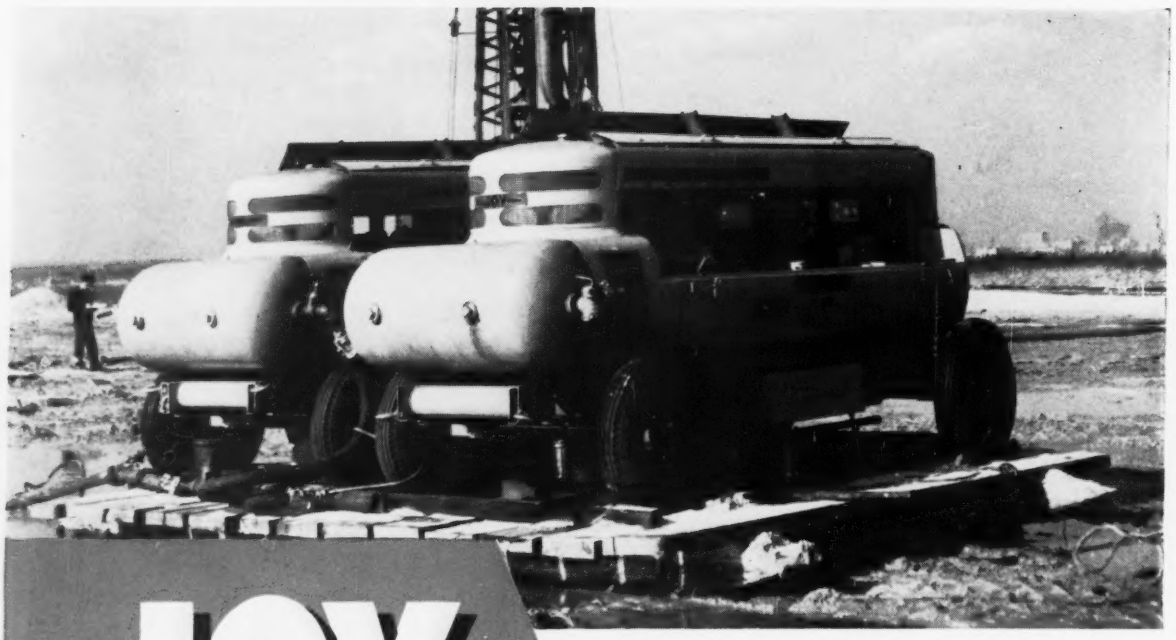

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"*Now* attach the detonating cap to the Primacord. Up to this point, your blast – hooked up with Primacord – cannot be set off by sparks, friction, ordinary shock or stray electric currents. Primacord *must* be detonated with a blasting cap attached to one end of the trunk line.

"Place the cap and fuse alongside the end of the Primacord trunk line and bind together lightly but firmly with friction tape. Don't tie them together with string or wire – don't lay them under a rock! Place the cap gently on the ground and lay out your length of safety fuse*.

"Remember – in blasting, safety is a sign of skill. Be careful, all-ways."

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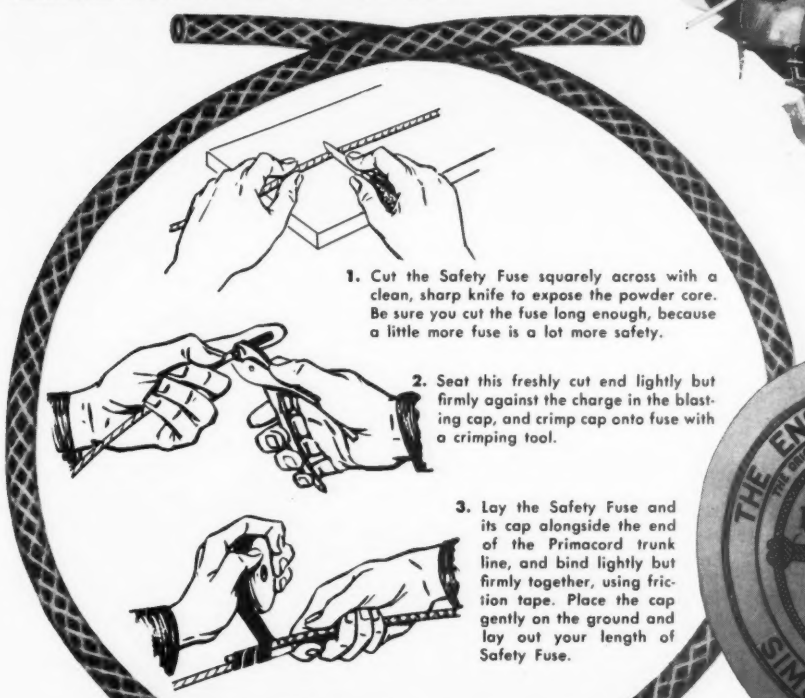
*Primacord can also be detonated with an electric blasting cap.



1. Cut the Safety Fuse squarely across with a clean, sharp knife to expose the powder core. Be sure you cut the fuse long enough, because a little more fuse is a lot more safety.

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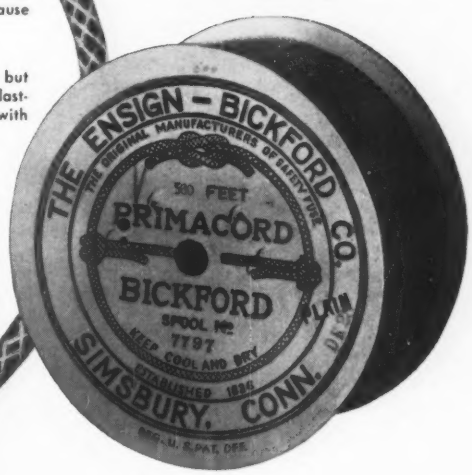
3. Lay the Safety Fuse and its cap alongside the end of the Primacord trunk line, and bind lightly but firmly together, using friction tape. Place the cap gently on the ground and lay out your length of Safety Fuse.



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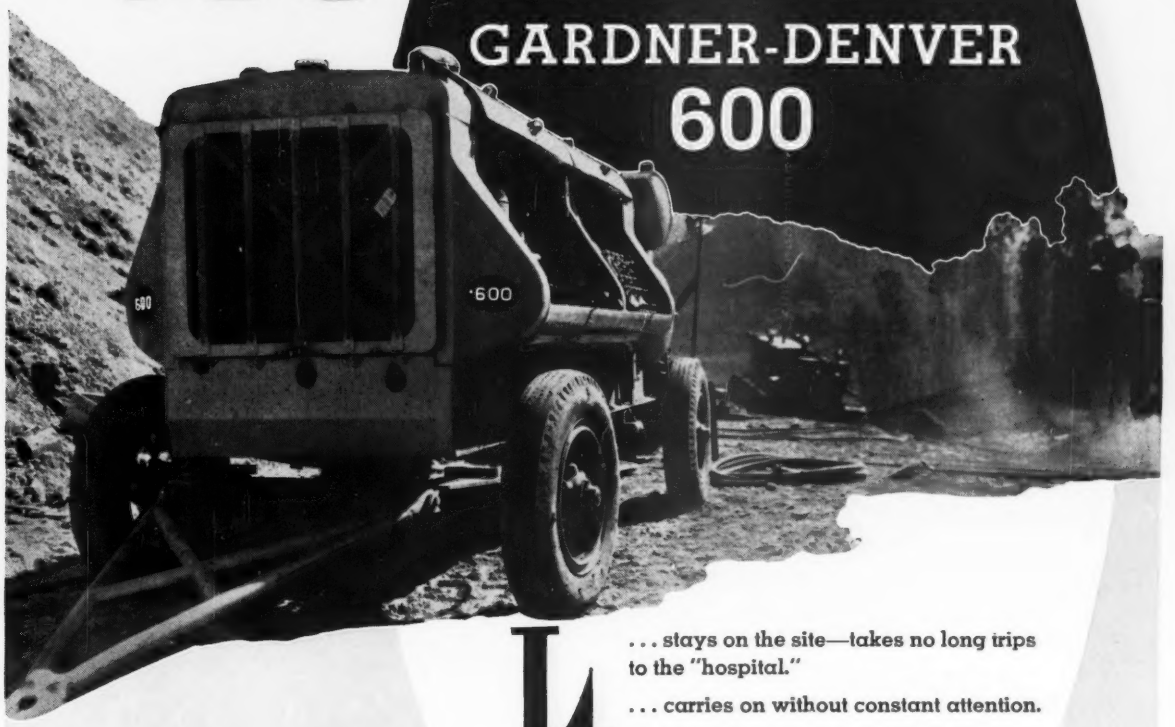

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